WEARABLE ELECTRONIC HEARING AID HAVING A UNITARY CASING FOR THE BATTERIES AND THE AMPLIFIER

Fig. 4

Fig. 5

Fig. 6

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WEARABLE ELECTRONIC HEARING AID HAVING A UNITARY CASING FOR THE BATTERIES AND THE AMPLIFIER

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17 Claims. (Cl. 179—107)

1. This invention relates to electronic hearing aids of the type wherein the electron tube amplifier and the supply batteries therefor are arranged in a common casing which is small enough to be worn in a pocket of the user.

It is an object of this invention to provide a hearing aid of the type mentioned which is of a particularly small size and at the same time reduces undesired capacitive interferences to a minimum.

It is a further object of the invention to provide a hearing aid of the type mentioned wherein at least one of the supply batteries is used for separating the choke coil or transformer of the electronic amplifier from one at least of the electron tubes of this amplifier.

Another object of the invention is to provide an electrostatic shield between the choke coil or transformer of the electronic amplifier and one at least of the electron tubes of this amplifier, using at least one of the current supply batteries as such shielding means.

Another object of the invention is to provide in a wearable electronic hearing aid wherein the elements of the amplifier are carried by a chassis extending longitudinally of the casing, a lower chamber in said casing delimited by the lower edge of said chassis in such a manner that this chamber will accommodate a rod-shaped battery in horizontal position underneath said chassis and, within a recess of the chassis, a tablett-shaped battery above the rod-shaped battery.

Still another object of the invention is to provide a hearing aid of the type mentioned, wherein metal strips arranged to both sides of the width of the chassis carrying the hearing aid elements extend over the major part of the length of the casing and receive between them the terminals of the aforementioned rod-shaped battery, being thereby held at constant potential.

A further object of the invention is to provide a hearing aid of the type mentioned wherein a partition wall projecting from the front wall of the casing towards the back wall thereof is arranged and shaped so as to divide the casing into two dovetailing compartments, the one of said compartments having a lower and an upper section, the lower section extending across the whole width of the casing and the upper section extending over a central part only of the width of the casing.

A further object of the invention is to utilize the clip commonly provided on wearable hearing aids for establishing an electrical connection between a point within the casing below the partition wall mentioned and a point likewise within the casing but above said partition wall.

Another object of the invention is to provide in a wearable electronic hearing aid which uses a battery cell of tablet form, a contact structure and housing for that battery which will hold the battery positively in position between two contact elements.

A further object of the invention is to render the just mentioned contact structure and housing for the tablet-shaped battery self-adjusting in the sense that, when the battery is inserted into the battery housing and left to itself, one of the contact elements will force the battery into a position in which it is in intimate contact with the other contact element.

Other objects of the invention will appear as the description proceeds, reference being had to the accompanying drawings in which—

Fig. 1 is a longitudinal sectional view of one embodiment of the invention;

Fig. 2 is a vertical sectional view on the line 2—2 of Fig. 1;

Fig. 3 is a horizontal sectional view on the line 3—3 of Fig. 1;

Fig. 4 is an elevational back view of the hearing aid with the back cover of the casing removed;

Fig. 5 is a fragmentary sectional view on the line 5—5 of Fig. 4;

Fig. 6 is a fragmentary sectional view on the line 6—6 of Fig. 4;

Figs. 7, 8, and 9 show a modified form of the contacting and housing structure for the tablet-shaped A-battery cell, the three figures showing the cell in three successive stages of insertion into the battery housing; and

Fig. 10 is a fragmentary view similar to Fig. 4 but with a battery housing of the kind shown in Figs. 7, 8, and 9, the tablet-shaped A-battery cell not being inserted.

Referring first to Figs. 1 to 6, the hearing aid comprises a casing A composed of a front cover 10, a lower back cover 11 and an upper back cover 12. The front cover 10 and the lower back
cover 11 are connected at the bottom end of the casing by means of a spring hinge 13 permitting the lower back cover 11 to be readily opened and removed. Extending across the casing between the side walls 14 and 15 of the front cover 10 and integral with this front cover is a partition wall 16 which divides the casing A into a lower compartment 11 and an upper compartment 18. The partition wall 16 is arranged and shaped so that the lower compartment 11 accommodates two batteries 19 and 20, 19 being a rod-shaped plate-supply B-battery, and 20 a tablet-shaped filament-supply A-battery. The upper compartment 18 is divided into a front space 21 and a rear space 22 by the metal strip 28. The partitions 11 and 22, whereas on the rear side of the chassis 23 other hearing aid elements are mounted, such as resistors (not shown), a volume control 29, a tone control combined with a switch 30, sockets 31, 32, and 33 for receiving the terminals of the electron tubes 25, 26, and 27, receptively, etc. The transformer 28 whose main portion is situated in the front space 21 extends with its rear portion through the panel 23 into the rear space 22.

It will be noted that the electron tubes 25, 26 and 27 of the electronic amplifier have their bulb extending parallel to the plane of the chassis 23 whereas the sockets 31, 32, and 33 for these tubes are arranged so that their axis extend perpendicularly to the plane of the chassis 23. The leading-in wires of the electron tubes 25, 26, and 27 are bent at right angles as described in the pendement application Serial No. 571,218, now U. S. Patent No. 2,431,198, of Sam Posen. The electron tubes can thereby be easily plugged in and out whenever replacement becomes necessary.

As has been mentioned above, the lower compartment 11 which receives the batteries 19 and 20, dovetails with the upper compartment 18 in which the electronic amplifier mounted, on the panel or chassis 23 is housed. For that purpose, the partition wall 16 has a raised middle portion 160 so that the lower compartment 11 comprises an upwardly extending projection or chamber 170 at an intermediate portion of the width of the casing A. Within this projection or chamber 170 the tablet-shaped A-battery cell 20 is placed with its axis substantially perpendicular to the front wall of the casing as well as to the axis of the rod-shaped B-battery 19. Over the upwardly extending portion 160 of the partition wall 16 fits a recess in the chassis 23, the latter thereby forming two legs 34 and 35 which extend downwardly to opposite sides of the projection 160 of the partition wall 16. On (and in) the leg 34 of the chassis 23 there is mounted the transformer 28 whereas the other leg 35 of the chassis 23 supports the electron tube 26 which, preferably, forms the second stage of the amplifier.

It will be observed that the dovetail arrangement just described not only provides for a very compact, space saving construction, but also secures a minimum of coupling between the transformer 28 and the tube 26 of the amplifier. By the interposition of the cell 20 between the tube 26 and the transformer 28, these latter two parts are kept at such a great distance from each other that practically no coupling will take place already for that reason. Furthermore, since the A-battery has an outer metal shell which is at a constant potential, it will serve as an electrostatic shield between the battery 19 and the tube 26. This shielding action of the battery 20 also extends to the tube 25, in regard to which the shielding action of the shell of the battery 20 is supported by the shielding action of the outer shell of the microphone 24 which is situated above the A-battery 25. Thus the A-battery 20 and the microphone 24 separate the transformer 28 and the output tube 27 from the two first stages 25 and 26 of the amplifier.

The B-battery 19 which has its terminals 38 and 39 at opposite ends, extends horizontally over the whole width of the interior of the casing A and is held between two contact strips 38 and 39. Each of these strips 38, 39 extends along one of the two opposite longitudinal edges of the chassis 23 over the major part of the length of said edges and downwardly beyond those edges down to the points of contact with the terminals 38 and 39 of the battery 19. The upper end of the metal strip 38 is secured to the chassis 23 at 46 whereas the upper end of the metal strip 39 is secured to the chassis 23 at 41. The strips 38 and 41 connect to some parts of the amplifier which are not shown. The metal strips 38 and 39, each of which is at the constant potential of the respective terminal of the battery 19, shield the amplifier sideways against external disturbances.

The outer shell 43 of the A-battery 20 makes contact with a resilient contact element 42 which is secured to the back side of the chassis 23, whereas the central terminal 44 at the top of the cell 20 makes contact with a contact plate 45 at the inner surface of the front wall 10 of the casing. This contact element 45 is connected with the conventional clip 46 of the instrument by means of a rivet 47 traversing the insulating material of the front wall 10 of the casing. While the contact element 45 is situated underneath the partition wall 16, a conductor 48 is located above said partition wall and passes through the front wall of the casing in order to make contact with the clip 46 to which it is conductively secured at 49 by soldering or the like. From the conductor 48 the conductor 49 leads, as is shown in Fig. 6, to an eyelet type solder lug 50 which fits into a bushing 51 formed at the rear side of the front wall 10 of the casing. The bushing 51 contains an inset 52 having its axis at 53 (Fig. 1) into which a screw 53 may be screwed from the back of the casing, the back wall 11 being thickened at that point to form a spacing collar 54 which, when the screw 53 is screwed in, abuts against the chassis 23. The screw 53 passes through a hole in the chassis 23 and then through a hole in a spring contact member 55 carried by the front side of the chassis 23. Connected with the spring contact member 55 by means of a rivet or the like 56 passing through the chassis 23 is a conductor 57, e. g., a wire, which leads either directly or via some intermediate elements to the switch 36. By tightening the screw 53, the spring contact member 55 is pressed tightly against the lug 50, establishing thereby a secure electrical connection between the conductors 48 and 51 situated to opposite sides of the chassis 23 and, in fact, between the battery terminal 45 situated next to the front wall of the casing below the partition wall 16 and the conductor 57 which is situated in the rear space 22 of the upper compartment 18.

While in the embodiment of the invention
While in Figs. 7 to 10 the battery housing is shown as being completely closed at its lower tip, the lowermost part of this housing may be eliminated, provided a portion of the lower half of the housing is maintained. This will permit the arrangement of the A-battery directly, that is to say without any spacing, above the B-battery.

While we have shown and described two specific embodiments of the invention, it is to be understood that these embodiments have been given by way of example only, since various changes and modifications may be made in the form and arrangement of the parts of the instrument without departing from the spirit of the invention or the scope of the appended claims.

What we claim is:

1. In a wearable electronic hearing aid, an electron tube amplifier having midget tubes and a transformer, supply batteries for said amplifier, said amplifier and batteries being arranged in a common casing small enough to be worn in a pocket of the user, a chassis in said casing extending longitudinally of the casing over part only of the length thereof and having mounted thereon said transformer and said tubes, at least one of said supply batteries being placed between said transformer and one at least of said electron tubes.

2. In a wearable electronic hearing aid, an electron tube amplifier having midget tubes and a transformer, supply batteries for said amplifier, said amplifier and batteries being arranged in a common casing small enough to be worn in a pocket of the user, a chassis in said casing extending longitudinally of the casing over part only of the length thereof and having mounted thereon said transformer and said tubes, at least one of said supply batteries being placed between said transformer and one at least of said electron tubes.

3. In a wearable electronic hearing aid, an electron tube amplifier having midget tubes and a transformer, supply batteries for said amplifier, said amplifier and batteries being arranged in a common casing small enough to be worn in a pocket of the user, said batteries comprising a rod-shaped B-battery and a tablet-shaped A-battery, a chassis in said casing extending longitudinally of the casing from the top end thereof to a line spaced from the bottom of the casing and having a recess formed in its bottom portion so as to leave in said casing a lower chamber, said rod shaped B-battery being placed at the bottom of said chamber with its axis extending horizontally and said tablet shaped A-battery being placed completely above said B-battery within said recess with its axis extending also horizontally but at an angle of 90° to said axis of said B-battery and to the plane of said chassis.

4. A wearable electronic hearing aid as claimed in claim 3 wherein the recess of the chassis is situated midway of the width thereof.

5. In a wearable electronic hearing aid, an electron tube amplifier and supply battery thereof arranged in a common casing small enough to be worn in a pocket of the user, said batteries comprising a rod-shaped B-battery and an A-battery, a chassis in said casing carrying said amplifier and extending longitudinally of the casing from the top end thereof to a line spaced from the bottom of the casing so as to leave a lower chamber in said casing for accommodating said B-battery in horizontal position underneath

shown in Figs. 1 to 6 the A-battery 20 is located in a recess of the partition wall 16 which is open at the bottom, the construction may be modified so that the A-battery 20 is securely held in place by a housing which surrounds only the upper half of the circumference of the battery as in the structure of Figs. 1 to 6, but follows the curvature of said battery also for a part at least of the lower half of the battery cell, preventing thereby the battery 20 from slipping downwardly even while the battery 18 is removed from the casing. Figs. 7 to 10 show one form of such a housing for the A-battery. Referring first to Figs. 7 and 10, 18 again denotes the front wall of the casing of the instrument and 46 the clip. Part of the front wall 10 of the casing forms the bottom 10' of an insulating housing which has a side wall 59 of approximately cylindrical shape and is open at the side opposite the bottom 10' except for a contact plate 67 which covers up a small portion of the opening of the battery housing. Secured to the bottom 10' of the battery housing is a spring contact member 61, which is connected to the clip 46 by means of a rivet 47' or the like. The side wall 59 has an inner surface which is partly in the shape of a cylinder whose axis is perpendicular to the bottom 10' and partly in the shape of a cylinder whose axis is at an angle to the axis of the first named cylinder. That portion of the inner surface which is part of a cylinder whose axis is perpendicular to the bottom 10' forms the upper limitation of the cavity in the battery housing and is indicated at 62, whereas the cylinder surface which is inclined relative to the bottom 10' is indicated at 63 and 64.

To insert the battery 20 into the battery housing it is slipped into that housing, using the incised inner surface 63 as a guide in the manner shown in Fig. 7. The lower edge of the contact plate 67 is shaped so (along a half circle) that it does not obstruct the insertion of the battery 20. Still using the surface 63 as a guide, the battery cell is pressed forwardly until it assumes the position shown in Fig. 8 in which it compresses the spring 64. Using the point of contact between the bottom 10' and the cell 20 as a pivot, the battery cell 20 is tilted slightly in counter-clockwise direction, bringing thereby the bottom of the cell underneath the projecting edge of the contact plate 67. Leaving now the battery 20 to 60 the spring 64 is compressed which, in turn, forces the battery 20 to 60 into the position shown in Fig. 9 in which it rests against the surface 62 of the inner wall of the battery housing and at the same time is pressed against the fixed contact plate 67.

The spring contact 61 which in the housing as shown in Fig. 9 presses upon the center of the battery will, as far as the junction point of parts 59, 67 is concerned, have the tendency to turn the battery in counter-clockwise direction. Such turning, however, made impossible by the fact that in the position of Fig. 9 the cell 20 bears directly against the wall 62 as well as against the wall 63, so that the cell is held wedged between the spring contact 61 and the fixed contact plate 67.

To remove the battery 20 from the battery housing, the battery is pressed towards the bottom 10', exerting the pressure not exactly in the center of the cell but at a point below that center whereby the battery is brought into the position shown in Fig. 8 from which it will slip past the fixed contact 61 into the position shown in Fig. 7 from which it can be easily removed.

While in Figs. 7 to 10 the battery housing is shown as being completely closed at its lower tip, the lowermost part of this housing may be eliminated, provided a portion of the lower half of the housing is maintained. This will permit the arrangement of the A-battery directly, that is to say without any spacing, above the B-battery.

While we have shown and described two specific embodiments of the invention, it is to be understood that these embodiments have been given by way of example only, since various changes and modifications may be made in the form and arrangement of the parts of the instrument without departing from the spirit of the invention or the scope of the appended claims.

What we claim is:

1. In a wearable electronic hearing aid, an electron tube amplifier having midget tubes and a transformer, supply batteries for said amplifier, said amplifier and batteries being arranged in a common casing small enough to be worn in a pocket of the user, a chassis in said casing extending longitudinally of the casing over part only of the length thereof and having mounted thereon said transformer and said tubes, at least one of said supply batteries being placed between said transformer and one at least of said electron tubes.

2. In a wearable electronic hearing aid, an electron tube amplifier having midget tubes and a transformer, supply batteries for said amplifier, said amplifier and batteries being arranged in a common casing small enough to be worn in a pocket of the user, a chassis in said casing extending longitudinally of the casing over part only of the length thereof and having mounted thereon said transformer and said tubes, at least one of said supply batteries being placed between said transformer and one at least of said electron tubes.

3. In a wearable electronic hearing aid, an electron tube amplifier having midget tubes and a transformer, supply batteries for said amplifier, said amplifier and batteries being arranged in a common casing small enough to be worn in a pocket of the user, said batteries comprising a rod-shaped B-battery and a tablet-shaped A-battery, a chassis in said casing extending longitudinally of the casing from the top end thereof to a line spaced from the bottom of the casing and having a recess formed in its bottom portion so as to leave in said casing a lower chamber, said rod shaped B-battery being placed at the bottom of said chamber with its axis extending horizontally and said tablet shaped A-battery being placed completely above said B-battery within said recess with its axis extending also horizontally but at an angle of 90° to said axis of said B-battery and to the plane of said chassis.

4. A wearable electronic hearing aid as claimed in claim 3 wherein the recess of the chassis is situated midway of the width thereof.

5. In a wearable electronic hearing aid, an electron tube amplifier and supply battery thereof arranged in a common casing small enough to be worn in a pocket of the user, said batteries comprising a rod-shaped B-battery and an A-battery, a chassis in said casing carrying said amplifier and extending longitudinally of the casing from the top end thereof to a line spaced from the bottom of the casing so as to leave a lower chamber in said casing for accommodating said B-battery in horizontal position underneath.
said chassis and two metal-strips extending along the two opposite longitudinal edges of said chassis over a substantial length of said edges and downwardly beyond those edges to receive between them the terminals of said B-battery, whereby said strips, when in contact with said terminals, shield said amplifier sideways against external disturbances.

6. In a wearable electronic tube hearing aid, an electron tube amplifier and supply batteries therefor arranged in a common casing small enough to be worn in a pocket of the user, said casing comprising a front wall, a back wall, side walls and a partition wall projecting from the front wall of the casing towards the back wall thereof, said partition wall being arranged and shaped so as to divide said casing into two dovetailing compartments of which two compartments the upper one accommodates said amplifier and the lower one said batteries, said lower of said compartments having a lower and an upper section, said lower section extending across the whole width of the casing for accommodating a battery of red oxide and said upper section extending only over an intermediate portion of the width of said casing and dovetailing with said upper compartment containing said amplifier, said upper section of said lower compartment accommodating a tabloid-shaped A-battery having its axis perpendicular to the axis of said B-battery.

7. In a wearable electronic hearing aid, an electron tube amplifier and supply batteries therefor arranged in a common casing small enough to be worn in a pocket of the user, said casing comprising a front wall, a back wall, and side walls, a partition wall projecting from said front wall towards said back wall, a chassis extending longitudinally of said casing from the top thereof down to said partition wall and dividing the upper portion of said casing into a front and back compartment, at least one of said batteries being of tabloid shape and arranged underneath said partition wall so that its axis extends substantially perpendicularly to said front wall and said back wall, said battery being electrically connected to said partition wall, a contact element at the inner surface of said front wall electrically connected through said front wall with said metallic member for contacting one terminal of said battery, when the latter is in place within the casing, a conductor electrically connected to said metallic member traversing said front wall at a point within said casing which is above said partition wall, said metallic member thereby establishing an electrical connection between the top thereof down to said partition wall and said back wall, said metallic member secured to the outside of said front wall, a contact ele-

8. In a wearable electronic hearing aid, an electron tube amplifier and supply batteries therefor arranged in a common casing small enough to be worn in a pocket of the user, said casing comprising a front wall, a back wall, side walls and a partition wall projecting from said front wall towards said back wall, a chassis extending longitudinally of said casing from the top thereof down to said partition wall and dividing the upper portion of said casing into a front and back compartment, at least one of said batteries being of tabloid shape and arranged underneath said partition wall so that its axis extends substantially perpendicularly to said front wall and said back wall, a metallic member secured to the outside of said front wall, a contact ele-

which is above said partition wall, said metallic member thereby establishing an electrical connection between said terminal of said battery below said partition wall and said conductor above said partition wall, said conductor connecting further to a fixed contact element carried by said front wall at the inner side thereof, a spring contact member carried by the front side of said chassis and adapted to be pressed against said fixed contact member by means of a screw extending through said back plate, said chassis and said spring contact member into said fixed contact element, an electric conductor behind said chassis being electrically connected to said spring contact member by means of a connector traversing said chassis, and a contact element secured to the back side of said chassis for contacting the second terminal of said battery.

11. An insulating battery housing having a side wall and a bottom and being open at the end which is opposite said bottom, part of the inner surface of said side wall being in the shape of a cylinder whose axis is inclined to said bottom with the exception of a portion of said inner surface adjoining the open end of said housing and extending over a part only of the circumference of said housing, which portion is undercut so as to form a surface which is part of the surface of a cylinder whose axis is perpendicular to said bottom and which intersects said inclined cylindrical surface at a distance from said bottom.

12. An insulating battery housing having a side wall and a bottom and being open at the end which is opposite said bottom, part of the inner surface of said side wall being in the shape of a cylinder whose axis is inclined to said bottom with the exception of a portion of said inner surface adjoining the open end of said housing and extending over a part only of the circumference of said housing, which portion is undercut so as to form a surface which is part of the surface of a cylinder whose axis is perpendicular to said bottom and which intersects said inclined cylindrical surface at a distance from said bottom.

13. An insulating battery housing for a battery cell having a cylindrical shell, said housing having a side wall and a bottom and being open at the end which is opposite said bottom, part of the inner surface of said side wall being in the shape of a cylinder whose axis is inclined to said bottom with the exception of a portion of said inner surface adjoining the open end of said housing and extending over a part only of the circumference of said housing, which portion is undercut so as to form a surface which is part of the surface of a cylinder whose axis is perpendicular to said bottom and which intersects said inclined cylindrical surface at a distance from said bottom.

14. An insulating battery housing for a battery cell having a cylindrical shell, said housing having a side wall and a bottom and being open at the end which is opposite said bottom, part of the inner surface of said side wall being in the shape of a cylinder whose axis is inclined to said bottom with the exception of a portion of said inner surface adjoining the open end of said housing and extending over a part only of the circumference of said housing, which portion is undercut so as to form a surface which is part of the surface of a cylinder whose axis is perpendicular to said bottom and which intersects said inclined cylindrical surface at a distance from said bottom.

15. An insulating battery housing for a battery cell having a cylindrical shell, said housing having a side wall and a bottom and being open at the end which is opposite said bottom, part of the inner surface of said side wall being in the shape of a cylinder whose axis is inclined to said bottom with the exception of a portion of said inner surface adjoining the open end of said housing and extending over a part only of the circumference of said housing, which portion is undercut so as to form a surface which is part of the surface of a cylinder whose axis is perpendicular to said bottom and which intersects said inclined cylindrical surface at a distance from said bottom.

16. A wearable electronic hearing aid as claimed in claim 3, wherein the chassis has two downwardly extending legs adapted to receive between them the tablet-shaped A-battery so that one of said chassis legs extends alongside said A-battery to one side thereof and the other of said legs extends alongside said A-battery to the opposite side thereof.

17. In a wearable electronic hearing aid, an electron tube amplifier and supply batteries therefor arranged in a common casings small enough to be worn in a manner that the casings comprising a front wall, a back wall, and side walls, a partition wall projecting from said front wall towards said back wall, at least one of said batteries being of tablet shape and arranged underneath said partition wall so that its axis extends substantially perpendicularly to said front wall and said back wall, a metal member secured to the outside of said front wall, a contact element at the inner surface of said front wall electrically connected through said front wall with said metal member for contacting one...
terminal of said battery when the latter is in place within the casing, and a conductor electrically connected to said metal member traversing said front wall at a point within said casing which is above said partition wall, said metal member thereby establishing an electrical connection between said terminal of said battery below said partition wall and said conductor above said partition wall.

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